Wallops Engineering Services Contract (WESC) Representative Task Orders

General Background for All Representative Task Orders

NASA, specifically the Applied Engineering and Technology Directorate (AETD) at the Wallops Flight Facility (WFF), requires engineering services in support of a dynamic and constantly changing number of projects and missions occurring at the Wallops Flight Facility. Engineering and technical activities managed and/or supported by AETD can range from large flight projects utilizing all elements of aerospace discipline (from design to fabrication to testing and launch operations); to small specific technology development activities; to the operation and implementation of basic engineering support services to its customers. These RTOs are an attempt to capture a broad spectrum of the work expected on the WESC (Wallops Engineering Services) contract.

The first RTO addresses contract engineering and technical implementation of a flight project that could occur at Wallops. This RTO is typical of a large multi-disciplinary effort in support of the Suborbital and Special Orbital Projects Directorate and other partnering entities in NASA.

The second RTO is intended to capture the broad engineering support services that AETD and its support contractors provide to Wallops. These services can include full responsibility for the operation of labs or functional capabilities by the contractor.

For both of the RTOs, a brief background is given, followed by a task description, along with applicable documents, period of performance, and deliverables. A wide scope of services is required in these RTOs, spanning many engineering disciplines within AETD. The offeror shall identify all assumptions made in responding to the RTOs.

WESC RTO 1
Multi-Spacecraft Carrier (MSC)

BACKGROUND:

WFF has demonstrated in recent years a unique ability to support quick response flight test missions; a primary example was the Max Launch Abort System (MLAS) flight test. AETD played a significant role in the MLAS effort, contributing discipline engineering and technician support in multiple areas to a team led by the NASA Engineering and Safety Center (NESC). Hardware was designed, fabricated and tested at WFF; integration and assembly of the test vehicle occurred at a WFF processing facility and the vehicle was launched from the WFF launch range. WFF has also recently demonstrated an ability to develop small satellite technologies through its 6U SmallSat effort. These projects, along with WFF long standing successful suborbital programs (Balloons and Sounding Rockets), provide a unique combination of capability.

WFF has been tasked by NASA Headquarters to serve as the primary agent for building the Multi-Spacecraft Carrier (MSC). The MSC is being proposed by NASA Headquarters (HQ) as a means to provide flight opportunities for the Instrument Incubator Program (IIP). NASA envisions a series of MSC missions that will be flown on small orbital-class launch vehicles from the Wallops launch range. The MSC will be a spacecraft with a standardized bus that accommodates a primary instrument but also deploys multiple small spacecraft. NASA HQ would like to baseline a concept that that utilizes the WFF 6U spacecraft and 6U Deployer for accommodation ofthe deployable satellites. NASA HQ is interested in having Wallops develop the elements of the standardized bus, including all subsystems:

- Structures and Mechanisms
- Power (including solar arrays and batteries)
- Command & Data Handling
- Telemetry & Communications
- Guidance, Navigation & Control
- Flight & Ground Software Architecture

NASA HQ has provided several high level requirements for the development of the primary bus:

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- Spacecraft will be built to “Class D” mission requirements per NPR 8705.4, Risk Classification for NASA Payloads. For example, EEE parts are not required to be radiation hardened.
- Spacecraft testing will be conducted at WFF
- Spacecraft will be compatible with a NASA-provided launch vehicle interface and fit within a defined fairing envelope
- Spacecraft bus will include provisions for accommodating a minimum of four 6U Deployers (provided as GFE along with their respective 6U small spacecraft). The 6U satellites will be selected for the mission by NASA and are independent of the MSC.

The initial mission to demonstrate this NASA HQ initiative has been named the MSC Demonstrator. For the MSC Demonstrator mission a plasma physics instrument suite, called WCTW, has been selected

that has heritage on previous sounding rocket missions. Pertinent WCTW instrument parameters for spacecraft bus design are as follows:

WCTW Interface Requirements
Mass: 150 lb.
Volume: 30 in. x 30 in. x 20 in. high
Data: Maximum 10 Mbps; 60 Mb/day minimum; Ethernet
On-Orbit Average Power: 100 W (not to exceed)

Mission Requirements
Communication Interface: NASA Ground Network
Pointing: 0.1 deg/sec slew; 20 arcmin pointing accuracy
Orbit maintenance: There is no orbit maintenance or orbit maneuvering requirements beyond those provided at separation by the Launch Vehicle
General Bus Requirements: The spacecraft bus subsystems will need to accommodate the WCTW instrument and the 6U Deployers.
Launch Vehicle Interface: The spacecraft bus will be compatible with a 38.8-inch Motorized Light Band separation system and fit within the fairing envelope provided in the LV Interface Requirements Document (IRD) (the fairing envelope for proposal purposes will be provided in the e-library).

The MSC Demonstrator spacecraft will also include accommodations for a minimum of four of the previously discussed 6U Deployer assemblies. The 6U satellites will be powered off until their ejection; therefore, there is no requirement for electrical interfaces to the satellites themselves. Information on the 6U Deployer interfaces is available in the e-library. Initiation of the 6U satellite deployments will be by scripted autonomous command with the ability to interrupt via ground command.

NASA will perform extensive simulations of the MSC Demonstrator mission parameters prior to final design of all systems and during pre-launch activities. A custom control center will be utilized as a supplement to the WFF Range Control Center as a means for proto-typing future instrument ground stations. This custom control center will be GFE; however, the contractor will be expected to support configuration, integration and testing of the ground and flight segments. Launch and mission operations are not included in the scope of the RTO.

MSC Demonstrator environmental testing will be conducted at Wallops. NASA will provide coordination and operator support for all test facilities utilized with the exception of the AETD-owned Thermal Vacuum chamber.

NASA Provided Documents (Provided at Task Initiation)

WCTW-1	WCTW Instrument Specifications
MSC LV-1	MSC Demonstrator LV Interface Requirements Document
MSC-1	MSC Project Requirements Document
MSC-2	MSC Demonstrator Mission Description
MSC-3	MSC Command & Data Handling Specification
MSC-4	MSC Flight Performance Specification
MSC-5	MSC Communication Subsystem Specification

MSC-6 MSC Power Subsystem Specification
MSC-7 MSC Mechanical Systems Requirements Document
MSC-8 MSC Flight and Ground Software Requirements Document

Period of Performance: This task will start at the beginning of contract year 2. NASA will launch the MSC Demonstrator at the end of contract year 3.

Task Parameters

Hardware: The total hardware ODC plug for the MSC Demonstrator is $6140K. Contractor responsibility includes logistics, procurement and material handling functions which are not included in the plug figures. Computers and necessary software will be provided for contract personnel by NASA.

Travel: Travel to instrument Technical Integration Meetings (TIMs), vendor visits, and off-site fabrication facilities shall have a travel plug of $110K.

On-site/Off-site: The offeror shall propose the most efficient strategy for obtaining hardware and fabrication services. Remaining MSC work shall be performed on-site.

Government Responsibilities: For this RTO NASA WFF Code 800 (Suborbital and Special Orbital Projects Directorate) will provide a Project Manager, Resource Analyst and Scheduler.

TASK DESCRIPTION

Task Structure: Task will have multiple work elements, segregated by discipline. See following work element (WE) descriptions.

WE 1: Systems Engineering Support

The Systems Engineering duties to be performed include:
- Perform and document requirements identification and analysis
- Perform development of and document system architecture design
- Perform and document concept of operations development
- Perform technical risk assessment
- Develop and document mass & power budgets
- Develop and document Master Equipment List
- Develop and document verification and test approaches
- Conduct and document system trade studies
- Produce other related engineering documentation and presentation material
- Support project meetings, including reviews. Support post-presentation follow-up and lessons learned forums

WE 2: Guidance, Navigation and Control Support

The GN&C Engineering duties to be performed include:

- Perform engineering design and analysis of MSC Demonstrator hardware, including attitude control system design, performance and analysis and orbit simulations, stability analysis, tip-off/separation analysis
- Specify system components and develop comprehensive design of MSC Attitude Control Systems
- Manage fabrication and/or procurement of flight and ground system hardware, subsystems, assemblies and test equipment; includes generation of drawings per GSFC standards referenced in the Statement of Work, Section 5.0.
    - Prepare necessary procedures for assembly and testing of MSC hardware
    - Perform Integration and Test activities for MSC subsystems and full test article integration activities
- In addition to engineering support, technician support will also be required during the fabrication, assembly, test and pre-launch phases of the project.
- Support project meetings, including reviews. Support post-presentation follow-up and lessons learned forums

WE 3: Mechanical and Thermal Engineering Support

The Mechanical Engineering duties to be performed include:

- Estimate, track and manage MSC mass properties
- Perform engineering design and analysis of MSC Demonstrator flight hardware, including bus mechanical structures, spacecraft separation mechanisms, telemetry and communication system mechanical packaging, and other subsystems
- Perform thermal engineering and analysis of MSC Demonstrator, including on-orbit thermal modeling, thermal control hardware design and analysis (blankets, coatings), and other necessary thermal engineering design and analysis
- Perform engineering design and analysis of Mechanical Ground Support Equipment (MGSE), including custom launcher hardware and support equipment
- Manage fabrication and/or procurement of flight and ground system hardware, subsystems, assemblies and test equipment; includes generation of drawings per GSFC standards
    - Prepare procedures for assembly and testing of MSC hardware
    - Perform Integration and Test activities for MSC subsystems and full test article integration activities as required
- Coordination of transportation and logistics for operations to move MSC hardware between two facilities (Wallops Flight Facilities: Main Base and Island Base)
- Develop and implement environmental test plans and procedures for qualification of flight and ground hardware
- Develop and provide any necessary engineering drawings and other configuration documents utilizing Autodesk Inventor, Pro-Engineer and other CAD tools
- In addition to engineering support, technician support will also be required during the fabrication, assembly, test and pre-launch phases of the project.
- Support project meetings, including reviews. Support post-presentation follow-up and lessons learned forums

WE 4: Electrical Engineering Support (includes Communications and Data Handling)

The Electrical Engineering duties to be performed include:

- Track and manage MSC power and data budgets
- Perform engineering design and analysis of MSC flight test hardware, including telemetry and communications subsystems, command and data handling subsystem, power system development (including solar arrays) and other subsystems
- Perform engineering design and analysis of Electrical Ground Support Equipment (EGSE)
- Manage fabrication and/or procurement of flight and ground system hardware, including harnesses, test cables and EGSE
- Prepare procedures for assembly and testing of MSC hardware
- Perform Integration and Test activities for MSC subsystems and full test article integration activities as required
- Develop and provide any necessary engineering drawings and other configuration documents utilizing EE CAD tools
- Provide harness fabrication and test support with certified personnel (NASA-STD-8739)
- In addition to engineering support, technician support will also be required during the fabrication, assembly, test and pre-launch phases of the project.
- Support project meetings, including reviews. Support post-presentation follow-up and lessons learned forums

WE 5: Software Engineering Support

The Software Engineering duties to be performed include:

- Perform and document development, tracking, and management of MSC software development schedule
- Perform and document design and development of MSC ground and flight software, including telemetry and communications interfaces
- Ensure that software complies with Agency, Center, and Project standards on CMMI, ISO, IV&V, and IT Security
- Prepare test plans and procedures of MSC software for component, subsystem, and acceptance testing
- Perform Integration and Test activities for MSC components, subsystems, and full test article as required
- Investigate discrepancy reports and change requests to identify solutions and to assess impacts and risks
- Coordinating inputs to the NASA-run Mission Planning Lab (MPL) simulations for MSC flight and mission planning
- Perform system administration of computer systems for project specific systems and servers
- Support project meetings, including reviews. Support post-presentation follow-up and lessons learned forums

The Contractor shall provide the following deliverables in accordance with the Task Description:

Deliverables List	Due Date
• MSC Spacecraft Bus Design Trade Study	2 months after TO issuance
• MSC Subsystem ICDs	4 months after TO issuance

- MSC-to-Launch Vehicle ICD 4 months after TO issuance
- MSC Mission Assurance Plan 8 months after TO issuance
- MSC Systems Safety Plan 8 months after TO issuance
- MSC Demonstrator Preliminary Design Review products 8 months after TO issuance
- MSC Demonstrator Critical Design Review products 12 months after TO issuance
- MSC Master Equipment List 12 months after TO issuance
- MSC Drawings 12 months after TO issuance
- MSC Test Procedures 18 months after TO issuance
- MSC Hardware Delivery 18 months after TO issuance
- MSC I&T Plans/WOAs 18 months after TO issuance
- MSC Test Reports 21 months after TO issuance
- MSC Demonstrator Mission Readiness Review products 22 months after TO issuance
- Weekly Status Reports Weekly
  (Includes Accomplishments, Issues, Labor Costs and ODCs by work element)

WESC RTO 2
Wallops Engineering Infrastructure and Mission Support

BACKGROUND:

AETD maintains and operates a diverse set of engineering labs and unique facilities at Wallops. These labs and facilities include areas dedicated to project support and hardware development, such as clean rooms, assembly and integration processing facilities, EMI/EMC and Anechoic Test Chambers, a GPS simulation lab, ESD Electronics labs, and Thermal Vacuum chambers; to continuous use labs such as a Secure Server Lab, Software Development Labs, a Mission Planning Lab, and small prototype machine shop areas. AETD also provides critical functions at Wallops including ongoing support services in the area of calibration, testing labs, systems administration, and facilities inspection. These facilities, labs and services all require contract support in the areas of sustaining engineering, systems development, assembly and testing, and technical operations and maintenance.

TASK:

WFF AETD requires support services from the contractor for the following Work Elements (WE):

WE 1: Thermal Vacuum Chamber Test Lab

This work element involves sustaining engineering and operations of the Mechanical Systems Branch – owned Thermal Vacuum (T-Vac) Chamber located in Building F-7 at Wallops (Reference information on the chamber is provided in the WES bidders' e-library). The contractor will provide operators, will maintain the chamber and all of its support systems in proper working order, will develop and maintain procedures and work instructions, and report annually on chamber usage and status. Current yearly usage of the chamber is as follows:

- Two major subsystem thermal vacuum tests: Each test is 15 days in duration, including setup and disassembly. These tests involve continuous chamber operations (24/7).
- Five smaller subsystem/component thermal vacuum tests: Each test activity is 5 days in duration, including setup and disassembly. Two of the five tests involve continuous chamber operations (24/7); the other three involve normal work hour testing.
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The offeror is expected to propose lab management as required in GPR 8730.7 Laboratory Management.

WE 2: System Administration Support Services

This work element involves providing Systems Administration support services to over 100 AETD civil servant and contractors and includes 200 pieces of equipment including desktops, laptops, servers, printers, and peripherals that are used in hardware and software development efforts. Reference Subtask 24 in the WESC bidders' e-library.

WE 3: Calibration Lab

This work element involves Calibration Lab services for IMTE for all Wallops organizations. Reference Subtask 21 in the WES bidders' e-library and assume the following: A total of 400 calibrations

performed per month; 15 pieces sent out for repair per month; 25 urgent (within 3 days) calibrations performed per month. The e-library also includes a list of existing equipment that is calibrated regularly. The offeror is expected to propose lab management as required in GPR 8730.7 Laboratory Management.

Period of Performance: NASA requires the support services outlined in this RTO to be provided for the entire 5 year period of performance.

General Performance Requirements:

- This task will be utilized for acquisition of hardware to be utilized in operation and maintenance of test facilities. Utilize a total hardware ODC plug of $45K per year. Utilization of a $10k per year travel plug is required. Computers and necessary software will be provided for contract personnel by NASA. Contractor Responsibility includes logistics, procurement and material handling functions which are not included in the plug figures.

Deliverables List	Due Date
• Weekly Status Reports (Includes Accomplishments, Issues, Labor Costs and ODCs by work element)	Weekly
• T-Vac Operations & Maintenance Report	Annually

Additional information on AETD test facilities, labs and services is available in the WES bidders' e-library: https://foiaelibrary.gsfc.nasa.gov/

Acronym List

AETD	Applied Engineering and Technology Directorate
CAD	Computer-Aided Design
CDR	Critical Design Review
CMMI	Capability Maturity Model Integration
COTS	Commercial Off The Shelf
EGSE	Electrical Ground Support Equipment
EMI/EMC	Electromagnetic Interference/
ESD	Electrostatic Discharge
GN&C	Guidance, Navigation & Control
GPR	Goddard Procedures and Requirements
GPS	Global Positioning System
GSFC	Goddard Space Flight Center
HQ	Headquarters
I&T	Integration and Test
ICD	Interface Control Document
IIP	Instrument Incubator Program
IMTE	Instrumentation, Measurement and Testing Equipment
IMU	Inertial Measurement Unit
ISO	International Standards Organization
IT	Information Technology
IVV	Independent Verification & Validation
LV	Launch Vehicle
Mbps	Megabits per second
MGSE	Mechanical Ground Support Equipment
MLAS	Max Launch Abort System
MPL	Mission Planning Lab
MSC	Multi-Spacecraft Carrier
NASA	National Aeronautics and Space Administration
NESC	NASA Engineering and Safety Center
NFS	NASA Financial System
PDL	Product Design Lead
PDR	Preliminary Design Review
RTO	Representative Task Order
SOS	Science on a SmallSat
SOW	Statement of Work
SSAT	SmallSat Advanced Technology
STD	Standard
TIP	Task Implementation Plan
TO	Task Order
T-Vac	Thermal Vacuum
UAS	Unmanned Aerial System
W	Watts
WE	Work Element

WESC	Wallops Engineering Services Contract
WFF	Wallops Flight Facility
WOA	Work Order Authorization